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Nannofossil biostratigraphy of the Oligocene deposits in the Grybów tectonic window (Grybów Unit, Western Carpathians, Poland)

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Abstract: The Grybów tectonic window belongs to the Grybów Unit of the Fore-Magura Group of units. This tectonic window is located in the marginal part of the Magura Nappe, and is composed of Oligocene — Grybów Marl Formation and Cergowa Beds. On the basis of calcareous nannoplankton investigation the Grybów Marl Formation has been assigned to Zone NP24, while the Cergowa Beds belong to Zones NP24–NP25. The Oligocene sequence of the Grybów tectonic window (Grybów Unit) display strong similarities to sediments of similar age in the inner part of the Dukla Unit in the Polish, East Slovak and Ukrainian sectors of the Outer Carpathians. On the basis of these similarities it is supposed that the Grybów Unit continues towards the south-east as an innermost part of the Dukla Unit (Ślączka 1971), and further on into the Ukrainian Carpathians as the Dusino (Berezna) Subunit within the inner part of the Dukla Unit.

Key words: Oligocene, Western Carpathians, Dukla and Grybów Units, calcareous nannofossil biostratigraphy, tectonic windows.

Introduction

In the middle part of the Polish sector of the Magura Nappe eleven tectonic windows were recognized. These windows belong to the Fore-Magura Group (FMG) of units, which occupied the intermediate position between the Silesian and Magura Nappes (Fig. 1). The Obidowa-Słopnice and Grybów Units, which are regarded as the western and southern prolongation of the Dukla Unit, occur in the tectonic windows. These units are composed predominantly of the Upper Eocene–Oligocene deposits. There is a common understanding (see Książkiewicz 1962; Bieda et al. 1963; Geroch et al. 1967; Koráb & Durkovič 1978; Olszewska 1981), that the FMG of units

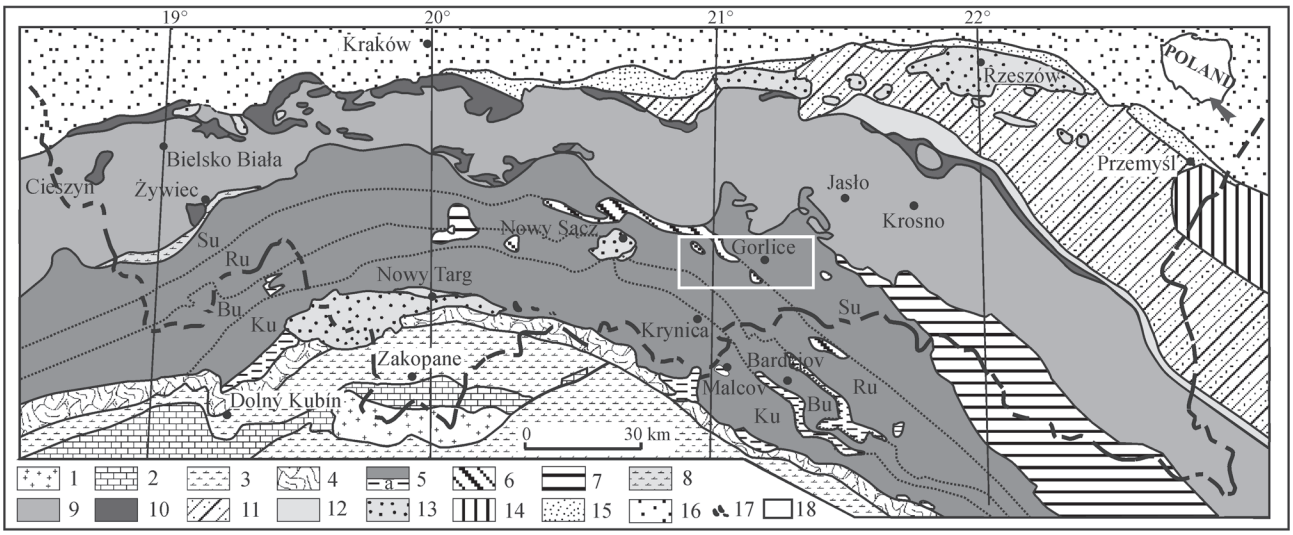

Fig. 1. Tectonic map of the northern Carpathians (compiled by Oszczypko-Clowes 2001). **1** — crystalline core of the Tatra Mts, **2** — High Tatra and sub-Tatra units, **3** — Podhale flysch, **4** — Pieniny Klippen Belt, **5** — Magura Nappe, **5a** — Malcov Formation, **6** — Grybów Unit, **7** — Dukla Unit, **8** — Fore-Magura Unit, **9** — Silesian Unit, **10** — Sub-Silesian Unit, **11** — Skole Unit, **12** — Lower Miocene, **13** — Miocene deposits upon the Carpathians, **14** — Stebnik (Sambir) Unit, **15** — Zgłobice Unit, **16** — Miocene of the Carpathian Foredeep, **17** — andesite, **18** — studied area. **Su** — Siary, **Ru** — Rača, **Bu** — Bystrica, and **Ku** — Krynica Subunits.

contain transitional lithofacies, which linked the Silesian and Magura Basins. In the last decade only a few studies have been carried out within the Grybów tectonic window and although their age is generally accepted as Oligocene there is still a need for more detailed biostratigraphic data.

The aim of this research was to establish the age of the youngest sediments of the Grybów Unit, represented by Grybów Marl and Cergowa Beds, and to settle their correlation with similar sediments from the adjacent areas. To solve this problem nannoplankton assemblages from Grybów Marl and Cergowa Beds were investigated in the Grybów tectonic window near Grybów town (Figs. 1, 2). A right tributary of the Strzylawka Stream was chosen for sampling, where the sediments in question are best exposed.

Geological setting

The Grybów Unit, also known as the Ropa-Pisarzowa Unit (Kozikowski 1956; Książkiewicz 1977), was established by Świdziński (map in scale 1:200,000). In the Polish sector of the Outer Carpathians this unit occurs below the Magura Nappe and is exposed in several tectonic windows within the marginal part of the nappe (Figs. 1, 2). Together with the Magura Nappe, the Grybów Unit is overthrust onto the Dukla Unit or Silesian Unit (Figs. 2, 3). The Grybów tectonic window is located ca. 2 km south of the front of the Magura Nappe and stretches between the town of Grybów in the SE and the Librantowa village in the NW. The tectonic window is 200–300 meters wide and up to 2 km long. The Upper Eocene?-Oligocene deposits of the Grybów Unit are surrounded by the Inoceramian Beds of the Magura Nappe (Paul 1991; Ślączka & Kamiński 1998).

Previous biostratigraphical studies

The age of the youngest sediments of the Grybów Unit is generally regarded as Oligocene. Hitherto existing biostratigraphical, nannofosil and foraminiferal research into this unit is scarce. The foraminiferal studies were conducted by Kozikowski (1956), Blaicher (in Sikora 1960, 1970), Olszewska (1981). According to Olszewska (1981), the Sub-Grybów (Klęczany and Ropa windows) and Grybów Beds (Klęczany and Mszana Dolna windows) are of Oligocene age.

Biostratigraphical studies based on nannofossils were initiated by Smagowicz (see Burtan et al. 1992; Cieszkowski 1992) in the Klęczany tectonic window. She recognized nannofossil associations from the Sub-Grybów Beds, which were characteristic for the latest Eocene–Early Oligocene (Burtan et al. 1992; Cieszkowski 1992). At the same time the Cergowa Beds (Sandstones) from Marcinkowice belong to the upper part of Lower Oligocene. Recently, a detailed calcareous nannoplankton study of the Grybów Unit was carried out in the Mszana Dolna and Szczawa tectonic windows (Oszczypko-Clowes & Oszczypko 2004). In the Mszana Dolna tectonic window the youngest deposits were assigned to NP24 (Krosno Beds, Dukla Unit) and NP23–NP25 (Cergowa Beds, Grybów Unit) Zones. Similar nannoplankton ages were also established in the Grybów Unit of the Szczawa tectonic window. Zones NP22–24 were determined in the Grybów Beds, whereas the Cergowa Beds belong to Zone NP24 (see Oszczypko-Clowes & Oszczypko 2004).

In the adjacent Dukla Unit calcareous nannoplankton studies were, so far, also sporadic and carried out by Smagowicz (Olszewska & Smagowicz 1977). Foraminiferal studies were lately conducted by Olszewska (1973, 1980). They proposed the biostratigraphical scheme of the Upper Cretaceous–Paleogene deposits from the Dukla Unit; which was based on foraminiferal and calcareous nannoplankton investigations.

Lithostratigraphy

The oldest sediments known from the Grybów Unit (Fig. 2) belong to the Jaworzynka Beds (Senonian–Paleocene, see Oszczypko-Clowes & Oszczypko 2004). The Lower to Upper Eocene green, grey and black shales, with intercalations of fine- to medium-grained glauconitic sandstones occur more frequently, and are known as the Hieroglyphic Beds (Sikora 1960, 1970) or the Klęczany Beds (Kozikowski 1956). Towards the top they pass into greenish marl, a few meters thick, representing the Upper Eocene with abundant *Globigerina*. This corresponds to the horizon of the Sub-Menilite Globigerina Marls (SMGM) known from the all units of the Outer Carpathians (Olszewska 1983; Leszczyński 1996, 1997; Oszczypko 1996; Oszczypko-Clowes 1998). The Early Oligocene is represented by a series of about 150 meters of grey, dark green and black marls, and marly shales with thin- and medium-bedded, micaceous, laminated sandstones and several thick-bedded, glauconitic sandstones (Sub-Grybów Beds) distinguished by Kozikowski (1956). The Sub-Grybów Beds pass upwards into the Grybów Marls first distinguished as Grybów shales by Uhlig (1888) and latter called by Kozikowski (1956) as Grybów Beds. Sikora (1960) named them again Grybów Shales. We propose to use the name Grybów Marl Formation. It is more appropriate due to their characteristic lithological development, vast distribution and their distinct lower and upper boundary. For typical section we propose the Strzylawka Stream with its southern tributary. The Grybów Marl Formation is represented by a series up to a few hundreds meters thick, consisting of black, hard, platy splitting marls with sporadic intercalations of thin- and medium-bedded dark grey, soft marls and thin- and medium-bedded dark sandstones (Figs. 3, 4). Within the upper part of the beds thick lenses of ferruginous dolomites (siderites) occur. Locally, black argillaceous shales are developed and thick-bedded, organodetritic sandstones occur singly. Within the highest part of the Grybów Marl Formation there are intercalations of black

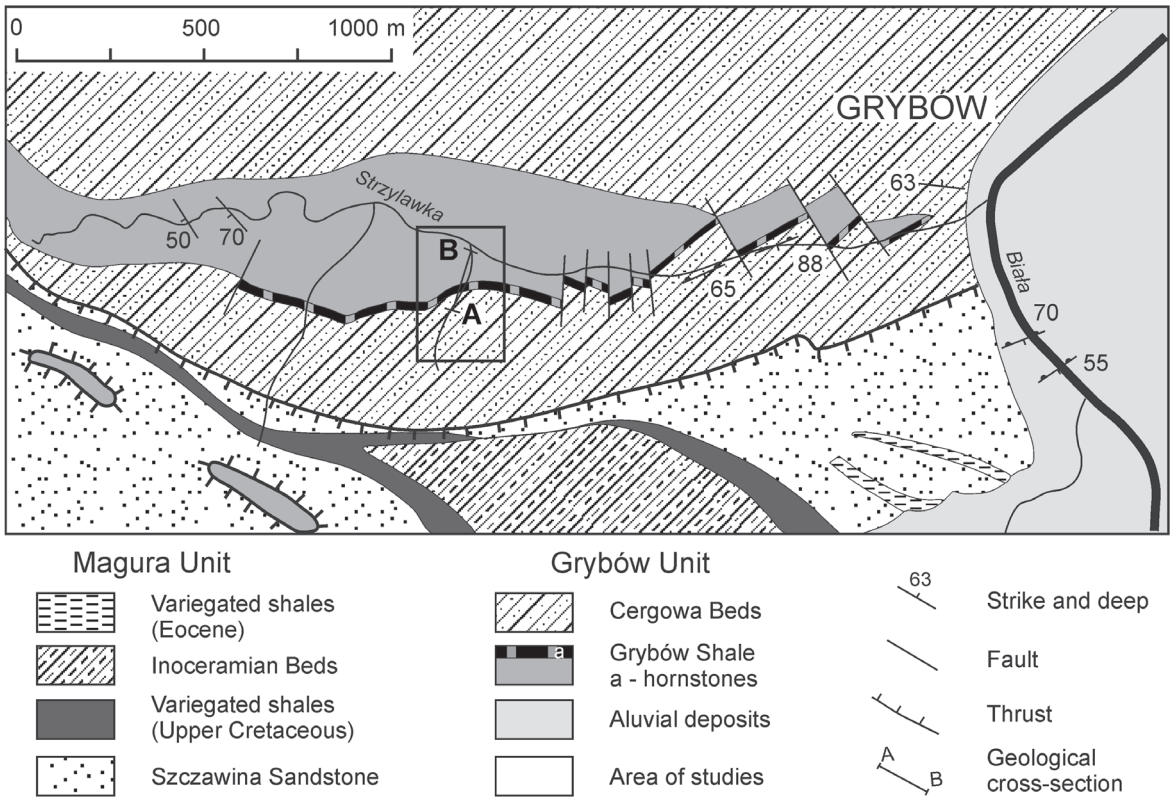

Fig. 2. Geological map of the Grybów tectonic window (after Ślączka 1973).

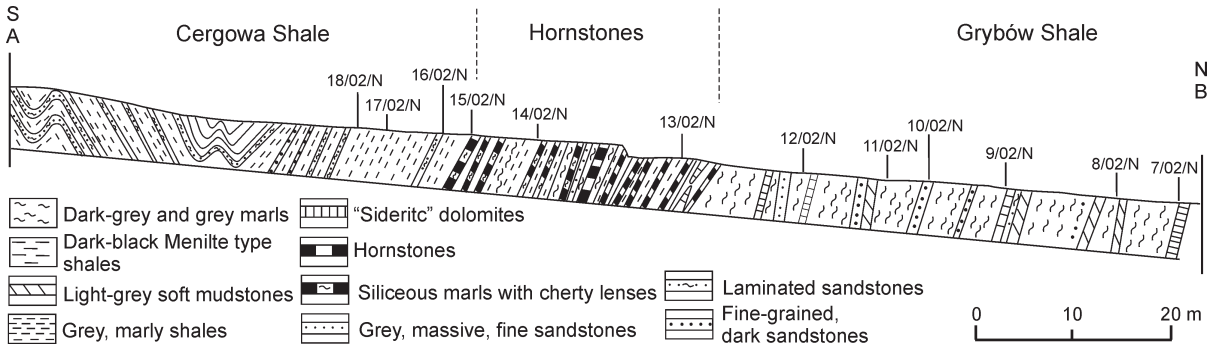

Fig. 3. Geological cross-section along the right confluent of the Strzylawka Stream in Grybów.

cherts and also brownish siliceous marls with cherty lenses (Figs. 3, 4). The lower boundary of the Grybów Marl Formation is placed at the top of grey-green marls from the Sub-Grybów Beds where the complex of black marls appears.

The Grybów Marl Formation is overlain by a sequence of more than 200 meters of grey calcareous shales with grey, micaceous and calcareous thin- and medium- or occasionally thick-bedded sandstones (Figs. 3, 4). The upper boundary of the Grybów Marl Formation is sharp and located where grey shales appear. The overlying sequence of grey marls and sandstones display thinning and finning upward sequence. These sediments were regarded as the Krosno Beds (Kozikowski 1956), but they probably represent the more shaly lithofacies of the Cergowa Beds, which are known from the Dukla Unit (Ślączka 1971; Koráb & Ďurkovič 1978).

Nannofossil biostratigraphy

Methods and sample preparation

During the field work 12 samples were collected from the small southern confluent of the Strzylawka Stream where a continuous sequence is exposed (Figs. 2, 3).

All samples were prepared using the standard smear slide technique for light microscope (LM) observations. The investigation was carried out under LM-Nikon–Eclipse E 600 POL, at a magnification of 1000× using

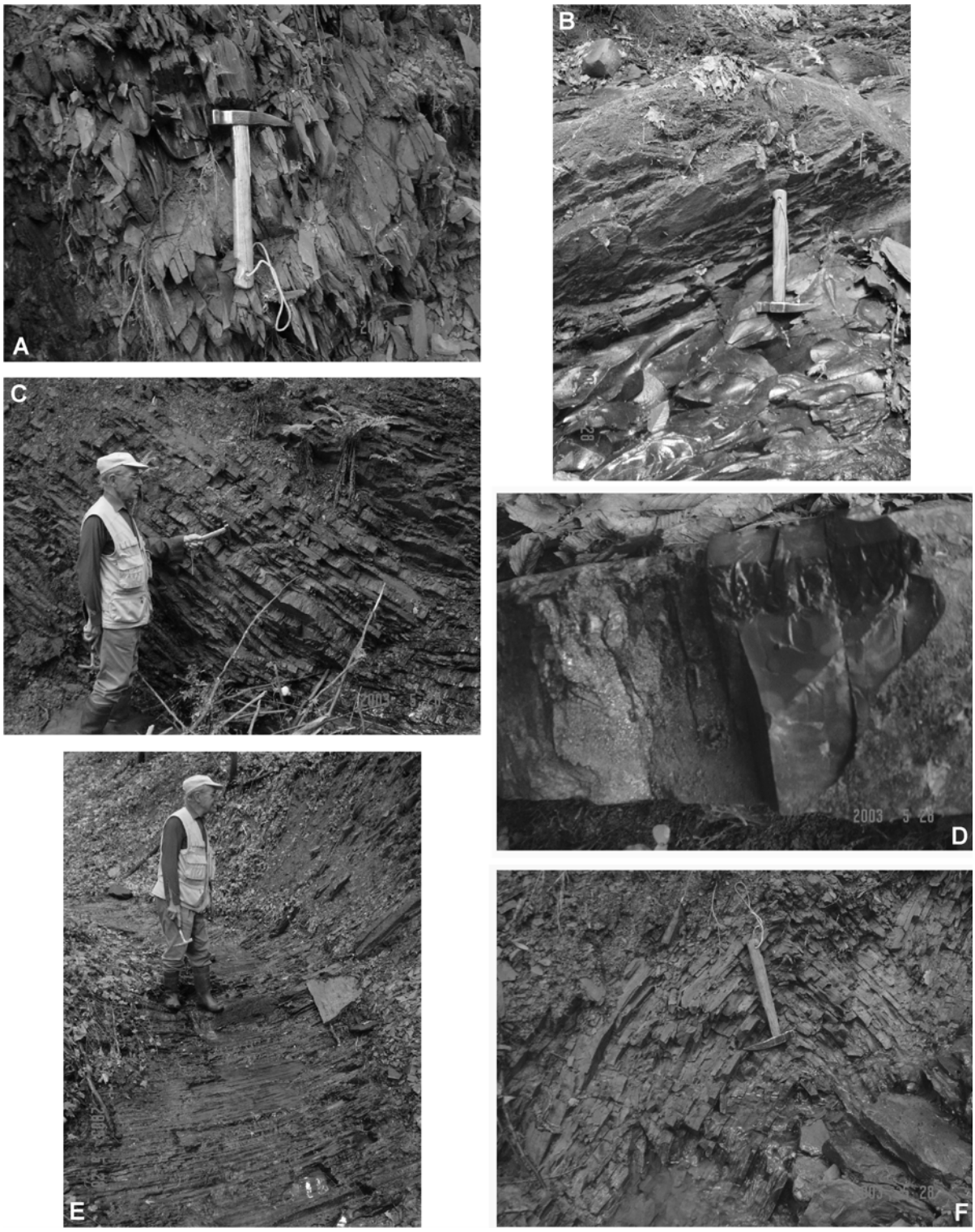

Fig. 4. Exposures of the Oligocene sediments of the Grybów Unit. **A** — Thick-bedded, massive, black marls with intercalations of grey marly mudstones, Grybów Marl Formation. Lower part of the right tributary of the Strzylawka Stream. Length of the hammer — 50 centimeters. **B** — Thick-bedded, massive black marls with intercalation of a thick layer of ferruginous dolomites. Strzylawka Stream. Length of the hammer — 50 centimeters. **C** — Thin- and medium-bedded cherts intercalated with very thin-bedded dark brown shales within the higher part of the Grybów Marl Formation. Right tributary of Strzylawka Stream. Second author for the scale (173 cm high). **D** — Layer of siliceous marl, 30 cm thick, with intercalation of chert with irregular lower boundary. The highest part of the Grybów Marl Formation. Right tributary of the Strzylawka Stream. **E** — Thin- and medium-bedded grey, laminated calcareous sandstones and grey marly shales. The lowest part of the Cergowa Beds. Higher part of the right tributary of the Strzylawka Stream. Second author for scale. **F** — Secondary folded Cergowa Beds in the higher part of the right tributary of the Strzylawka Stream.

parallel and crossed nicols. Several of the specimens photographed in LM are illustrated in Fig. 5.

Results

The majority of the examined samples yield moderately-preserved nannofossil assemblages. The relative abundance of samples is usually medium to low (Table 1).

Grybów Beds (the samples 7-14/02/N). The autochthonous assemblage is characterized by the presence of *Coccolithus eopelagicus* (Bramlette et Riedel), *C. pelagicus* (Wallich), *Cyclicargolithus abisectus*, *C. floridanus* (Roth et Hay), *Dictyococcites bisectus* (Hay, Mohler et Wade), *Neococcolithes dubius* (Deflandre), *Reticulofenestra dictyoda* (Deflandre), *R. lockerii* Műller, *R. minuta*, *R. ornata* Műller, *Sphenolithus dissimilis* Bukry et Percival, *S. moriformis* (Brönnimann et Stradner). The most abundant are *C. abisectus*, *C. floridanus*, *D. bisectus* and *C. pelagicus*. The youngest species determining the age are *C. abisectus* and *S. dissimilis.*

Cergowa Beds (15-18/02/N). The nannofosil association is characterized by the co-occurrence of *Coccolithus eopelagicus*, *C. pelagicus*, *Cyclicargolithus abisectus*, *C. floridanus*, *Dictyococcites bisectus*, *Sphenolithus moriformis*,

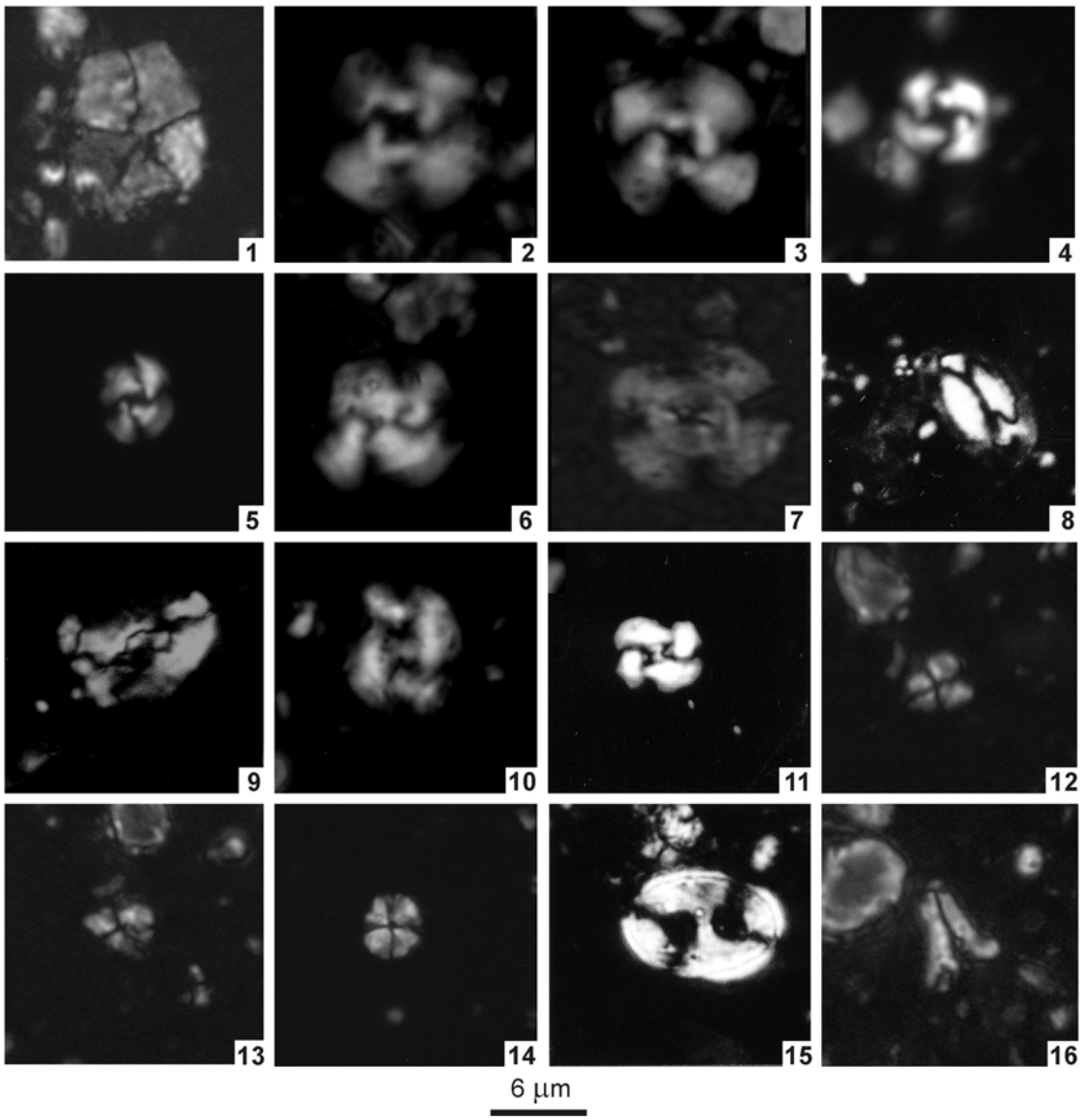

Fig. 5. LM microphotographs of calcareous nannofossils from the Oligocene deposits of the Grybów tectonic widows. **1** — *Braarudosphaera bigelowii,* sample 8/02/N. **2** — *Cyclicargolithus abisectus,* sample 7/02/N. **3** — *Cyclicargolithus abisectus,* sample 15/02/N. **4** — *Cyclicargolithus floridanus,* sample 8/02/N. **5** — *Cyclicargolithus floridanus,* sample 16/02/N. **6** — *Dictyococcites bisectus,* sample 8/02/N. **7** — *Dictyococcites bisectus,* sample 18/02/N. **8** — *Helicosphaera compacta,* sample 7/02/N. **9** — *Helicosphaera euphratis,* sample 7/02/N. **10** — *Reticulofenestra lockerii,* sample 7/02/N. **11** — *Reticulofenestra lockerii,* sample 18/02/N. **12** — *Sphenolithus conicus,* sample 16/02/N (//CN). **13** — *Sphenolithus conicus,* sample 16/02/N (45°/CN). **14** — *Sphenolithus moriformis,* sample 7/02/N. **15** — *Transversopontis pulcher,* sample 14/02/N. **16** — *Zygrhablithus bijugatus,* sample 18/02/N.

Table 1: Calcareous nannofossil distribution in Grybów section. **X** — species determined and not reworked, **R** — reworked species.

G R Y B Ó W	O L I G O C E N E											
Lithostratigraphical units	Grybów Marl Formation								Cergowa Beds			
Nannoplankton Zones Martini (1971)	NP 24	NP 24	NP 24	NP 24	NP 24	NP 24		NP 24	NP 24	NP 25	NP 25	NP 25
Sample number	7/02/N	8/02/N	9/02/N	10/02/N	11/02/N	12/02/N	13/02/N	14/02/N	15/02/N	16/02/N	17/02/N	18/02/N
Braarudosphaera bigelowii		X					–		X	X		X
Coccolithus eopelagicus	X	X	X	X	X	X	–			X	X	X
Coccolithus pelagicus	X	X	X	X	X	X	–	X	X	X	X	X
Coronocyclus nitescens							–					
Cyclicargolithus abisectus	X	X	X	X	X		–	X	X	X	X	X
Cyclicargolithus floridanus	X	X	X	X	X	X	–	X	X	X	X	X
Cyclicargolithus luminis							–		X		X	
Dictyococcites bisectus	X	X	X	X	X	X	–	X	X	X	X	X
Ericsonia fenestrata				X			–		X			
Ericsonia formosa			R		R		–				R	
Helicosphaera euphratis	X						–					
Helicosphaera compacta	X	X					–					
Isthmohlithus recurvus	R	R	R	R	R		–	R	R			
Lanternithus minutus		R	R	R	R	R	–	R	R		R	R
Reticulofenestra daviessi		X			X		–		X		X	
Reticulofenestra dictyoda	X	X	X	X		X	–	X	X	X	X	X
Reticulofenestra lockerii	X		X	X			–	X	X		X	X
Reticulofenestra minuta			X	X			–		X	X	X	X
Reticulofenestra ornata	X	X	X	X		X	–		X	X	X	X
Reticulofenestra umbilica			R				–	R	R			
Sphenolithus calyculus											X	
Sphenolithus conicus										X	X	X
Sphenolithus dissimilis				X			–				X	X
Sphenolithus moriformis	X	X	X	X	X		–	X	X	X	X	X
Sphenolithus pseudoradians			X				–			X		
Sphenolithus radians		R	R	R								
Transversopontis fibula										R		
Transversopontis pulcher								X				X
Zygrhablithus bijugatus	X	X	X	X	X	X	–	X	X	X	X	X

Zygrhablithus bijugatus (Deflandre). The most important species are *C. abisectus* and *S. dissimilis*. Samples 16–18/02/N also contained *S. conicus* Bukry.

Biostratigraphical interpretation

For the purpose of biostratigraphic analysis the standard zonation of Martini (1971) was used. The Oligocene nannoplankton zonation is mainly based on the last (LO) or first occurrence (FO) of sphenoliths. These typically warm water species are rare or absent in the higher latitudes. This is why, in those areas, the secondary zonal markers should be used (Bizon & Műller 1979; Biolzi et al. 1981; Perch-Nielsen 1985; Martini & Műller 1986; Berggren et al. 1995; Melinte 1995; Fornaciari et al. 1996).

In the studied area the nannofossil association described, from the Grybów Beds allow us to determine Zone NP24. The FO of *Cyclicargolithus abisectus* is usually found close to the FO of *Sphenolithus ciperoensis* (zonal marker for the lower boundary of Zone NP24) and thus can be used to approximate the NP23/24 boundary (Martini & Műller 1986). In addition, *Sphenolithus dissimilis* Bukry et Percival was also observed. The FO of these species is characteristic for Zone NP24 (see Perch-Nielsen 1985).

The nannofossil zones determined within the Cergowa Beds are not older than NP24 and NP25. The assignment of Zone NP25 is based on the first occurrence of *Sphenolithus conicus* and followed by a continuous range of *Cyclicargolithus abisectus*, *Dictyococcites bisectus* and *Zygrhablithus bijugatus*. The LO of *Dictyococcites bisectus*, is the biostratigraphical event marking the upper limit of NP25 (Berggren et al. 1995; Fornaciari et al. 1996). In order to separate NP24 Zone from NP25, especially for areas with limited connection to the open ocean (e.g. Paratethys), the FO of *Pontosphaera enormis* has proven to be a useful event (Martini 1981). If there is a lack of *Pontosphaera enormis* the FO of *Sphenolithus conicus* can approximate the boundary between NP24 and NP25 (Baldi-Beke 1981) Zones. The FO of *Sphenolithus conicus* has been traditionally used as the base of Zone NN1. However, Bizon & Műller (1979), Biolzi et al. (1981) and Melinte (1995) have observed the FO of these species as low as in the upper part of Zone NP25.

Corellation and discussion

On the basis of lithological characteristics and the nannofossil age determination it is possible to correlate

the Oligocene deposits of the Grybów Unit from the Grybów tectonic window with that of the Grybów Unit in the other tectonic windows as well as with Dukla Unit, in Poland, Eastern Slovakia and Ukraine (Fig. 6).

The Oligocene sequence and calcareous nannoplankton ages of the Grybów tectonic window correlate well with the Grybów Marl Formation and Cergowa Beds of the Grybów Unit of the Mszana Dolna and Szczawa tectonic windows (Oszczypko-Clowes & Oszczypko 2004). There is also a good correlation with the same deposits of the Grybów Unit, Klęczany-Pisarzowa (Burtan et al. 1992), Ropa (Sikora 1960, 1970) and Świątkowa Wielka (Koszarski & Koszarski 1985) tectonic windows. The Grybów Marl Formation also displays some similarities to the Menilite Formation deposits and the overlying Cergova Beds to the finely rhythmic Krosno Formation exposed in the Smilno tectonic window (Stráník & Hanzlíková 1968).

The Oligocene sequence of the Grybów tectonic window (Grybów Unit) displays strong similarities to the sediments of the same age present in the inner part of the Dukla Unit in the Polish, East Slovak and Ukrainian sectors of the Outer Carpathians.

The Sub-Grybów Beds show some similarities to the Papin Beds (Koráb & Kotlarczyk 1977; Koráb & Ďurkovič 1978) known from the innermost part of the Dukla Unit in the Medzilaborce area (SE Slovakia). The Papin Beds were defined by Leško (1958) as deposits of mixed Magura and Krosno facies. Leško's conclusion (1958) is based on the presence of 'Zlin lithotype' (quartziitic sandstones with glauconite, and olive-green calcareous shales) characteristic of the northern part of the Magura Nappe. A detailed investigation of Koráb & Ďurkovič (1978) documented the regional distribution of these lithofacies in the Sub-Menilite Beds of the Dukla Unit. According to these authors the Papin Beds (50–300 m thick) are composed of "calcareous, micaceous aleurolites with both horizontal and convolute lamination, fine-grained sandstones, and sandy and organogenous-detrital limestones", and occasionally submarine slump deposits. In the upper parts of the Papin Beds black calcareous shales are also known. According to Samuel & Salaj (1968) foraminiferal assemblages of the Papin Beds and of the Globigerina Marl horizon (SMGM) are the same. Within the Papin Beds assemblages with *Globigerina danvillensis* Howe et Wallace, *G. ouachitanensis* Howe et Wallace and *G. officinalis* Subbotina were found (Koráb & Ďurkovič 1978).

On the other hand glauconitic sandstone and slump deposits within the Sub-Grybów Beds show some similarity to the Mszanka Sandstones Complex from the Dukla Unit. The age is also similar, as all these deposits ranged from the Eocene/Oligocene boundary to the lowermost Oligocene?. In the lower part of the Mszanka Sandstones, above the SMGM, the nannofossil association indicates Early Oligocene (Ślączka et al. 1991). Towards the southeast where the Mszanka Sandstone Complex is replaced by brownish shales and marls (Sub Cherts marls, Ślączka 1971) their age was also determined as Early Oligocene (Olszewska & Smagowicz 1977).

The Grybów Marl Formation shows a strong similarity to the Jawornik (Sub-Cergowa) Marls, especially to those from the SE part of the Polish section of the Dukla Unit where Jawornik Marls are less siliceous than in marginal part. The lithology also corresponds to the Menilite Beds in the inner part of the Slovak Dukla Unit (Medzilaborce lithofacies). According to Leško & Samuel (1968) and Koráb & Ďurkovič (1978) the lower part of the Menilite Beds in this area consist of black and dark brown marls with intercalations of black shales and thick layers of ferruginous dolomites. The middle part of these Beds is characterized by the occurrence of cherts and black shales, whereas the upper part of the Menilite Beds is composed of black, brown and dark grey calcareous claystones with sporadic sandstone intercalations.

In the south-eastern part of the Dukla Unit of the Ukrainian Carpathians, the Dusino Beds can be regarded as the equivalent of the Grybów Marl Formation (Vialov 1954; Danysh 1973). These beds reach 375 m in thickness. The lower part of these beds is composed of black, calcareous shales with intercalations of grey mudstones and occasional cherts. The middle part of the beds are fine-rhythmic couplets of grey calcareous mudstones, black and grey shales, and black silicified limestones, while the upper part of the beds consist of black and dark grey calcareous shales with intercalations of thin-bedded sandstones and very thin layers of cherts (see Gavura in Pasternak 1988).

The Dusino lithofacies are also known from the Marmarosh Flysch Zone (Smirnov 1973; Oszczypko et al. 2005).

In Poland, Slovakia and Ukraine the black marly shales of the Grybów type are regarded as the Oligocene. The age of Jawornik Marl was established as the Early Oligocene. This age is based on foraminiferal assemblages with the characteristic species *Globigerina officinalis* Subbotina, *G. ampliapertura* Bolli, *G. angustiumbilicata* Bolli, *G. droogeri* Mjatluk, *G. oauchitaensis* Howe et Wallace and *Bulimina* cf. *tenera* Reuss (Olszewska in Ślączka 1985).

Within the lower part of the Dusino Beds, Oligocene assemblages with *Subbotina vialovi* Mjatluk, *Globigerina brevispira* Subb., *G. officinalis* Subb. and *G. postcretacea* Mjatl. were described (Danysh 1970) and an assemblage with *Globigerina danvillensis* Howe et Wallace, *Acarinina rugosoaculeata* Subb., *Guembelina gracillima* Andrae, *Bolivina antegressa* Subb., *Uvigerina pygmea* d'Orbigny, *Cibicides lopjanicus* Mjatl., *Globorotalia pseudoscitula* Glaesner, *Asterigerina rogali* Mjatl and *Globigerinella* aff. *naguwichiensis* Mjatl. (Maslakova et al. 1959, see also Gavura, in Pasternak 1988). In the basal portion of the Dusino Beds in the Malyj Vyzhen section calcareous nannoplankton belonging to Zone NP22 were found, whereas in the uppermost part of these Beds Zone NP25 was determined (Gavura, in Pasternak 1988).

In the Terebla section of the Vezhany Succession (Marmarosh Flysch Zone) Dusino-type marls (Luh Beds) contain calcareous nannoplankton belonging to Zone NP24 (Oszczypko et al. 2005).

The sequence above the Grybów Marls, assigned to the Cergowa Beds, shows a strong similarity to the youngest sequence in the inner part of the Dukla Unit both in the Polish and Slovak parts of the Dukla Unit. The latter is

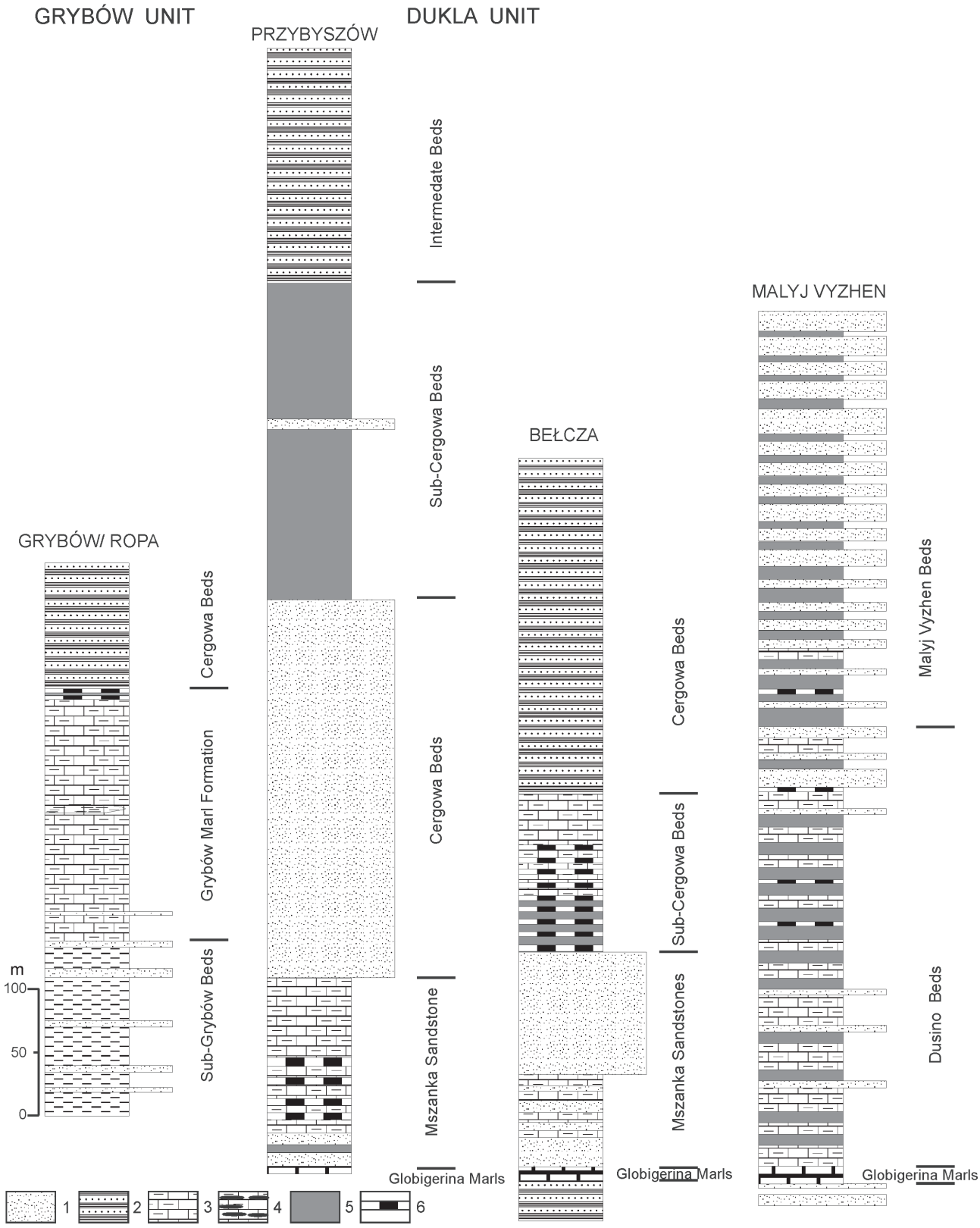

Fig. 6. Lithostratigraphic correlation of Grybów and Dukla Unit in Poland and Ukraine (Malyj Vyzhen section after Gavura 1988). **1** — thick-bedded sandstones, **2** — thin-bedded sandstones and shales, **3** — grey thick-bedded marls, **4** — spherosiderites, **5** — dark brown shales, **6** — hornstones.

also regarded as the Cergowa Beds. They consist of a complex of grey calcareous shales and thin- to medium-bedded, micaceous calcareous sandstones.

In the southeastern part of the Dukla Unit of Slovakia (Koráb & Ďurkovič 1978), the Menilite Beds are overlain by thin-bedded turbidites composed of grey, grey-brown shales and black calcareous shales of the Cergowa Beds. They alternate with aleurolites and fine-grained laminated calcareous sandstones. In these beds intercalations of the Tylawa limestones have been found. The Cergowa Beds, up to 300 m thick, terminate the bed sequence of the Dukla Unit in Eastern Slovakia.

In the Ukrainian Carpathians the Dusino Beds are overlain by the Malyj Vyzhen Beds (300 m thick). These beds are composed of thin-, medium- to thick-bedded, poorly calcareous, muscovitic sandstones. The sandstones are intercalated by thin layers of black, non-calcareous shales.

The age of the Cergowa Beds within more sandy development (Cergowa Sandstones) west of Jaśliska, based on foraminiferal contain assemblages with *Turborotalia liverovskae* (Bykova) was regarded as Early? Oligocene, not younger than Zone P19/20 (Olszewska 1980). Similar age for the Cergowa Sandstones was accepted in Slovakia on the basis of *Globigerina officinalis* Subbotina, *G. postcretacea* Mjatluk, *G. (Turborotalia). liverovskae (*Bykova), *Chilogumbelina gracillima* Andrae, *Cibicides lopjanicus* Mjatluk, (Samuel & Salaj 1968). Further towards the SE in the inner part of the Dukla Unit in Ukraine, the Cergova Beds are more sandy, and named Malyj Vyzhen Beds (Danysh 1973). In these Beds nannofossil association with *Sphenolithus ciperoensis* regarded as NP25 Zone was found (see Gavura, in Pasternak 1988).

Conclusions

1. The Grybów Marls display a very characteristic lithological development with a distinct lower and upper boundary and can be regarded as a Formation.

2. On the basis of nannofossil data the Grybów Marl Formation belongs to the Zone NP24.

3. The youngest deposits of the Grybów tectonic window are equivalent to the Cergowa Beds and correspond to the Zones NP24 and NP25.

4. The Oligocene sequence of the Grybów Unit displays strong similarities to the sediments of similar age developed in the inner part of the Dukla Unit and represents generally more inner and western part of the Dukla Basin.

5. Taking into account lithofacies similarities, it is suggested that the Grybów Unit continues towards the southeast as an innermost part of the Dukla Unit (Ślączka 1971), and further on into the Ukrainian Carpathians as the Dusino (Berezna) Subunit within the inner part of the Dukla Unit. Towards the west the Grybów Unit is exposed within the Szczawa and Mszana tectonic windows.

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